

Central Air Conditioner and Heat Pump National Energy Savings Spreadsheet Documentation

U.S. Department of Energy

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The Central Air Conditioner and Heat Pump National Energy Savings Spreadsheets (NES) calculate the national energy and dollar savings from a central air conditioner or heat pump efficiency standard. The models (one for central air conditioners and one for heat pumps) use input from the shipments models regarding air conditioner or heat pump purchases and compares the energy use between a baseline scenario and the standard case. Because two sets of manufacturer costs are being analyzed, one based on data submitted by the Air Conditioning & Refrigeration Institute (ARI) and the other based on data developed from a reverse engineering analysis (Rev Eng) conducted by Arthur D. Little, Inc. (ADL), each model allows for one of the two cost options to be selected.

The **Welcome** worksheet is the main user interface for NES calculations. When the user clicks on the **Welcome** worksheet tab, it brings up a user interface that can be run for different standard levels and scenarios for energy price projection, start year, discount rate, price option (either ARI or Rev Eng), and system type (either split or package).

Basic Operating Instructions:

1. Once you have downloaded the NES files from the Web, open one of the files using Excel. At the bottom, click on the tab for the worksheet labeled **Welcome**.
2. The screen will display two tables (*Electricity Savings in Quads* and *Cost and Net Present Values*) and a chart (*Cost and Savings of Central A/C or Heat Pumps* depending on which model is being used). (Use Excel's **View/Zoom** commands to change the size of the display to make it fit your monitor.)
3. To run different scenarios or standards cases, simply select the energy price projection, standard, the start year, the price option (either based on ARI or reverse engineering manufacturer costs), and the type of system (either split or package) from the appropriate list box. The result will be calculated immediately.
4. The user may also input values for the discount rate by directly typing the desired values into the appropriate input box, highlighted in yellow. Again, after the value is input (i.e., after you type the value and then hit <Enter>), the result will be calculated immediately.

Using these steps you can explore the potential outcomes of a range of alternative assumptions.

Frequently Asked Questions (FAQ)

How many NES spreadsheets are there?

There are currently two NES spreadsheets; one for central air conditioners (**nes_cac.xls**) and another for heat pumps (**nes_hp.xls**). Each spreadsheet allows the user to perform NES analyses of either split or single package systems. The user can also choose between two sets of manufacturer costs; one based on data submitted by the Air Conditioning & Refrigeration Institute (ARI) and the other based on data developed from a reverse engineering analysis (Rev Eng) conducted by Arthur D. Little, Inc. (ADL).

What do the Central Air Conditioner and Heat Pump NES Spreadsheets do?

The central air conditioner and heat pump NES spreadsheets provide an estimate of the national energy and monetary savings of different air conditioner and heat pump efficiency standards. The spreadsheets use estimates of future air conditioner or heat pump sales and stock from the shipments models for the chosen standard level to estimate potential savings from the standard. It also calculates the dollar value of these savings year-by-year. It estimates the amount of energy that will be saved at the source by considering transmission and distribution losses. It also calculates the monetary savings that can result from a standard and the net present value of such savings.

What are the Worksheets in the Workbook?

The worksheets in each of the workbooks are as follows:

Welcome

This worksheet is the main user page. It provides six list boxes that allow the user to choose a range of scenarios, plus an additional input box (highlighted in yellow) where the user can type in a desired input value directly. The five list boxes allow the user to choose the following: (1) growth projection for energy prices, (2) the base case standard level, (3) the standard case standard level, (4) the standard start year, (5) the price option (i.e., ARI or Rev Eng), and (6) the type of system (i.e., split or package) to be analyzed. The additional input box allows the user to change the discount rate. Different elements of the national energy savings are illustrated, including total electricity savings, the dollar value of energy savings, and the benefit/cost ratio for the standard case.

Base Case

The Base Case worksheet calculates the base case energy use and monetary costs (i.e., what is

projected to happen in the absence of an efficiency standard). The sheet contains the base case estimates of the population of central air conditioners or heat pumps in each age category and in each year. It then uses this information to calculate the base case energy consumption and operating cost. It also computes the operating and equipment costs for each year.

Standards Case

Calculates the standard case energy use and monetary costs. The sheet contains the estimates of the population of central air conditioners in each age category and each forecast year for the standard case selected by the user on the Welcome worksheet. It then uses this information to calculate the standard case energy consumption and operating cost. It also computes the operating and equipment costs for each year.

Engineering

This worksheet contains the data on total installed prices and annual repair and maintenance costs for central air conditioners or heat pumps meeting different standard levels. The data from this sheet are used to calculate the per unit installation price and repair and maintenance cost for each standard level. Both split system and package system data are held in this worksheet. The type of system selected in the **Welcome** worksheet dictates which set of data are analyzed.

Energy Price

Contains the tables that provide the energy price data for different energy price projection scenarios. These scenarios include the Annual Energy Outlook (AEO) high-growth, low-growth and reference cases (<http://www.eia.doe.gov/oiaf/aeo99/homepage.html>). There is also an option for constant energy prices, and an estimate from the Gas Research Institute (GRI).

Shipment Summary

This worksheet provides the tables of the population of central air conditioners or heat pumps (in millions of units) for each age group, for each year, and for each standard level. These populations of central air conditioners or heat pumps are obtained from the central air conditioner and heat pumps shipments models. The shipments forecast calculation begins in 1953, so that any computational transients in the model can die down by the time that forecasts are being made. Because central air conditioners and heat pumps can have lifetimes as long as 24 years, purchases in the 1950's can effect sales behavior in the 1970's.

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The worksheet contains the conversion factors that describe how much of the energy at the point of generation arrives at the point of use. These conversion factors are necessary for converting savings at the point of use to savings at the point of generation and distribution.

Split to Package

This worksheet contains the relative market share by year of split and package systems. The market share data here is multiplied by the total shipments data held in the **Shipment Summary** worksheet to arrive at the year-by-year shipments for split and package systems. Shipments data from the Air Conditioning & Refrigeration Institute (ARI) were used to establish the relative split-to-package market share for the years 1976 through 1994. For simplicity, it was assumed that relative market shares for years prior to 1976 were equal to the shares in 1976 while for years beyond 1994 shares were assumed to remain constant to those in 1994.

Setup

This worksheet contains the data that represents the current scenario selected in the **Welcome** worksheet. These values change as the user selects different scenarios to calculate.

How does the user operate the spreadsheet?

The user operates the spreadsheet by going to the **Welcome** worksheet and choosing the parameters and selections for the scenarios of interest. The possible scenarios include the energy price scenarios, the standard start year, one of five possible standard levels, the type of system (i.e., either split or package), the price option (i.e., ARI or Rev Eng), and the discount rate. The results will be displayed in the chart on the **Welcome** worksheet and in the tables which detail changes in energy use and operating cost savings.

What kind of output does the spreadsheet generate?

The spreadsheet provides output as charts, summary statistics, and detailed tables. Summary figures and charts are provided on the **Welcome** worksheet.

What does the chart entitled *Costs and Savings of Central A/C or Heat Pumps* illustrate?

For each year from the standard start date to 2030, the *Costs and Savings of Central A/C or Heat Pumps* chart shows the additional cost (labeled *Price Change*) to consumers to purchase the higher efficiency central air conditioners or heat pumps mandated by the standard, vs. the amount saved by consumers in reduced energy (labeled *Energy Saving*). The net saving to consumers is the difference between the money saved in energy bills minus the additional money spent on higher efficiency space-conditioning equipment. This net saving is shown as a red line labeled *Net Saving* on this chart.